Two new and two known species of the genus *Togoperla* (Plecoptera: Perlidae) from Guangxi of southern China

Raorao MO[1, 2], Guoquan WANG[1①], Ding YANG[3], Weihai LI[2①]

1. *Guangxi Key Laboratory of Agric-Environment and Agric-Products Safety and National Demonstration Center for Experimental Plant Science Education, Agricultural College, Guangxi University, Nanning, Guangxi 530004, China*

2. *Department of Plant Protection, Henan Institute of Science and Technology, Xinxiang, Henan 453003, China*

3. *Department of Entomology, China Agricultural University, Beijing 100193, China*

Abstract: Two new species of the genus *Togoperla* are described from Guangxi, China: *T. caii* **sp. nov.** and *T. hippata* **sp. nov.** *Togoperla perpicta* Klapálek, 1921 and *T. triangulata* Du & Chou, 1999 from the same region are diagnosed and re-described. The taxonomic relationships are discussed with related congeners.

Key words: Perlinae; taxonomy; distribution

广西襟襩属 *Togoperla* 二新种和二已知种补充记述（襩翅目：襩科）

莫娆娆[1,2]，王国全[1①]，杨定[3]，李卫海[2①]

1. 广西大学农学院广西农业环境与农产品安全重点实验室和植物科学国家级实验教学示范中心，广西南宁 530004; 2. 河南科技学院植物保护系，河南 新乡 453003; 3. 中国农业大学昆虫学系，北京 100193

摘要：记述采自中国广西的襟襩属 2 新种：彩氏襟襩 *Togoperla caii* **sp. nov.** 和河马襟襩 *Togoperla hippata* **sp. nov.**。重新描记了采自同地区的长形襟襩 *Togoperla perpicta* Klapálek, 1921 和三角襟襩 *Togoperla triangulata* Du & Chou, 1999，并分别与该属内相近种进行了比较。

关键词：襩亚科；分类；分布

Introduction

The perlid genus *Togoperla* Klapálek, 1907 of the subfamily Perlinae includes fourteen known species from the eastern Palearctic and Oriental region (DeWalt *et al*. 2021). Contribution of eight Chinese species of the genus have been made by Du & Chou (1999), Li & DeWalt (2012), Sivec *et al*. (1988), Wu (1935, 1938), Wu & Claassen (1934) and Yang & Li (2018). Seven are recorded from Guangxi (excluding *T. fortunati* Navás, 1926): *T. canilimbata* (Enderlein, 1909), *T. condyla* Li & DeWalt, 2012, *T. noncoloris* Du & Chou, 1999, *T. perpicta* Klapálek, 1921, *T. totanigra* Du & Chou, 1999, *T. triangulata* Du & Chou, 1999 and *T. tricolor* Klapálek, 1921 (Du & Sivec 2004; Yang & Li 2018). In this paper, two additional *Togoperla* species from Guangxi of southern China bordering Vietnam, *T. caii* **sp.**

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① Corresponding authors, E-mails: wangguoquan0@163.com; lwh7969@163.com

nov. and *T. hippata* **sp. nov.**, are described as new to science. Re-descriptions and re-illustrations of *T. triangulata* are presented based on our recent material. The rediscovery and brief comment on *T. perpicta* are also provided and this species is recorded from Guangdong Province for the first time.

Material and methods

Specimens were collected using sweep nets, light traps or by hand and stored in 75% ethanol. Studied specimens are deposited in the Insect Collection of Henan Institute of Science and Technology, Xinxiang (HIST), the Entomological Museum of China Agricultural University, Beijing (CAU) and the National Museum Prague (NMP) of the Czech Republic, as indicated in the text. The specimens were examined with the aid of an Olympus SZ61 dissecting microscope, and color illustrations were made with a VHX-S650E microscope and the aid of Imaging Source CCD attached to a Leica S8APO. The terminalia were removed and cleared in 10% NaOH. Aedeagi were everted using the cold maceration technique of Zwick (1983). The morphological terminology follows that of Li & DeWalt (2012) and Stark & Sivec (2008).

Taxonomy

1. ***Togoperla caii* sp. nov.** (Figs 1–3)

Adult habitus (Fig. 1). General body color brown. Head pale brown, with a large, dark brown semicircular medial area laterally interrupted by a pair of slender and oval tentorial callosities, and with a dark brown subtriangle in frontal region. Compound eyes dark; antennae brown. Pronotum dark brown, trapezoidal, with indistinct rugosities and a pair of small paler anterolateral area; anterior corners pointed and posterior corners obtuse (Fig. 1A). Wing membrane brown, veins dark brown. Legs dark brown; femora with wide pale band, nearly two thirds of total length; pale band of tibiae wide and nearly half of total length; basal half of tarsi paler (Fig. 1B). Abdominal segments brownish.

Male (Figs 1C, 1D, 2). Forewing length 22.0–23.4 mm. Mid-posterior margin of tergum 5 produced as a trapezoidal emarginate lobe. Terga 6–9 typical, with anterior margin and lateral areas sclerotized and midsection membranous; membrane of terga 6–9 hairy (Figs 1C, 1D). Hemitergal process forward of basal callus slightly shorter than basal callus, apex wide and obtusely rounded in lateral view, basal callus bearing sensilla basiconica (Figs 1C, 1D). Aedeagus membranous, cylindroid, apically abruptly constricted to a small tubular lobe (Fig. 2). Aedeagal tube bare, dorsobasally with a large tongue-shaped lobe. Aedeagal sac slightly bulging, basal half fully covers brownish spinules; apical half naked except apical tubular lobe armed with fine brownish setal spines.

Female (Fig. 3). Forewing length ca. 25.5 mm. Sternum 7 slightly sclerotized; posteromedian area sclerotized. Subgenital plate subtrapezoidal, subapically slightly constricted, with a posteromedian triangular notch nearly extending to middle of sternum 9 (Figs 3A, 3B). Sternum 9 slightly sclerotized with a pair of brown lateral spots (Figs 3A, 3B). Vagina subrectangular; spermathecal stalk slender; spermatheca sausage-shaped, shorter than

vagina in length, with a swollen apex; spermathecal accessory glands small, plentifully occurring at distal one third (Figs 3C, 3D).

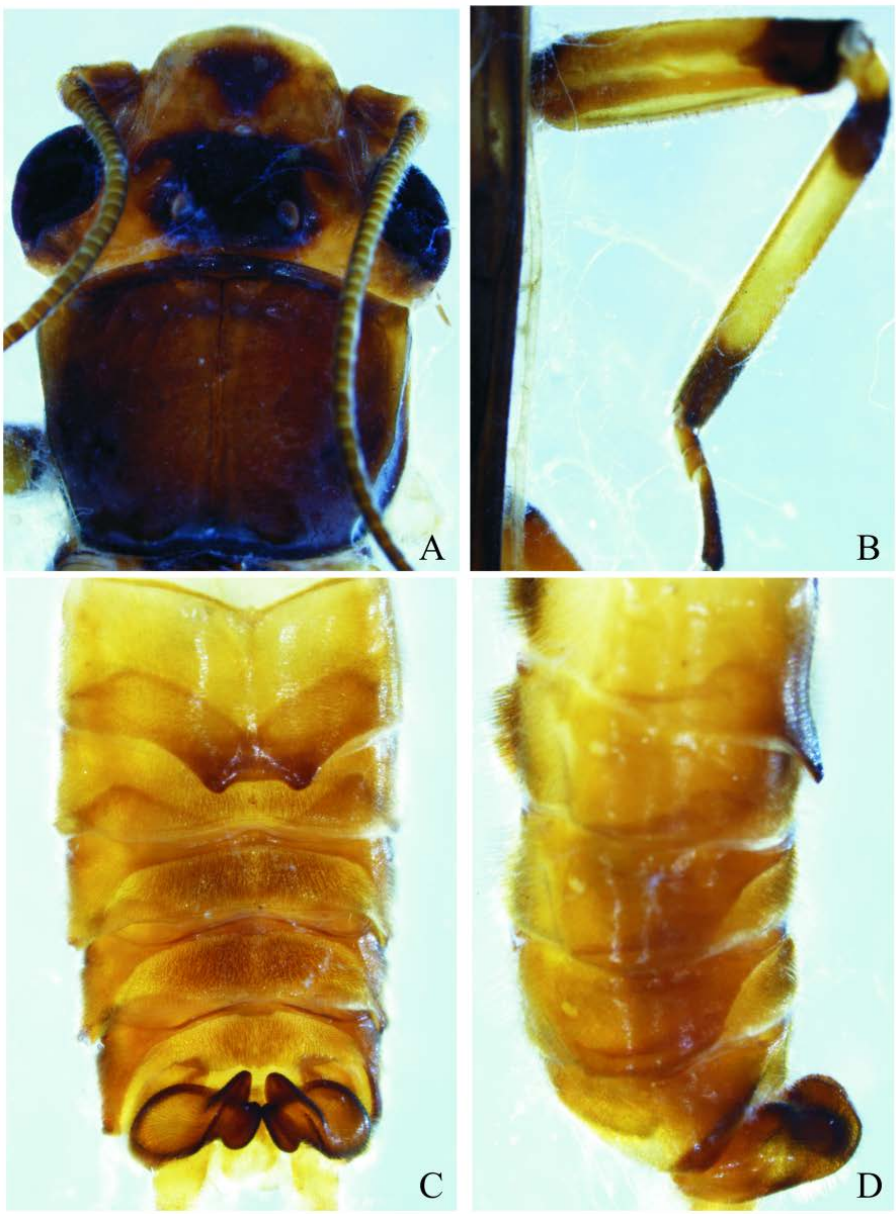

Figure 1. *Togoperla caii* **sp. nov.**, ♂. A. Head and pronotum, dorsal view; B. Right mid leg, outer face; C. Terminalia, dorsal view; D. Terminalia, lateral view.

Eggs. Available females were void of matured eggs.

Holotype. ♂ (CAU), **China**, Guangxi, Guilin, Longsheng, Huaping National Nature Reserve, 25°37'37" N, 109°54'41" E, 734 m, 01-V-2008, Wanzhi CAI. **Paratypes**. 1♂ (HIST), 1♂1♀ (CAU), same data as holotype.

Etymology. This patronym honors the collector of the types, Prof. Wanzhi CAI.

Remarks. The male of this new species is characterized by the shorter hemitergal processes, aedeagal tube only with a large dorsobasal lobe, and aedeagal sac only with a single tubular lobe which distinguishes this species from all other known *Togoperla* species. *Togoperla caii* **sp. nov.** is most similar to *T. hippata* **sp. nov.**, in having a similar head pattern, short hemitergal processes, aedeagal tube with only a single lobe and naked apical half of aedeagal sac. *T. caii* can be easily separated from the latter by aedeagal sac with only a single apicomedial lobe. In *T. hippata*, aedeagal sac has a pair of dorsolateral lobes and a longer finger-shaped apicomedial lobe. In addition, basal half of aedeagal sac of *T. caii* fully armed with spinules, while in *T. hippata*, basal half of aedeagal sac mostly covered with spinules but dorsomedially interrupted by narrow membranous band.

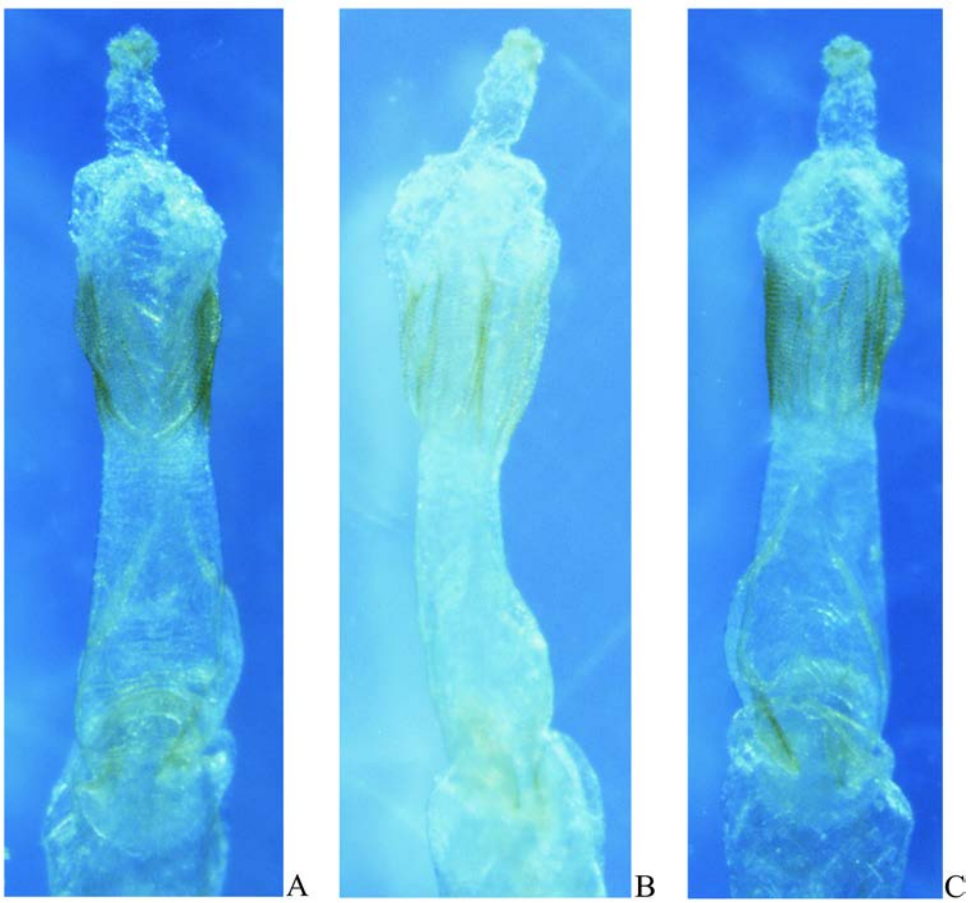

Figure 2. *Togoperla caii* **sp. nov.,** ♂. A. Aedeagus, dorsal view; B. Aedeagus, lateral view; C. Aedeagus, ventral view.

Togoperla caii and *T. hippata* are also similar to *T. fortunati* (Navás, 1926) in sharing a similar aedeagal tube with only a single dorsobasal lobe and without apical dorsolateral lobes. However, the two species are easily distinguished from the latter by their short hemitergal processes.

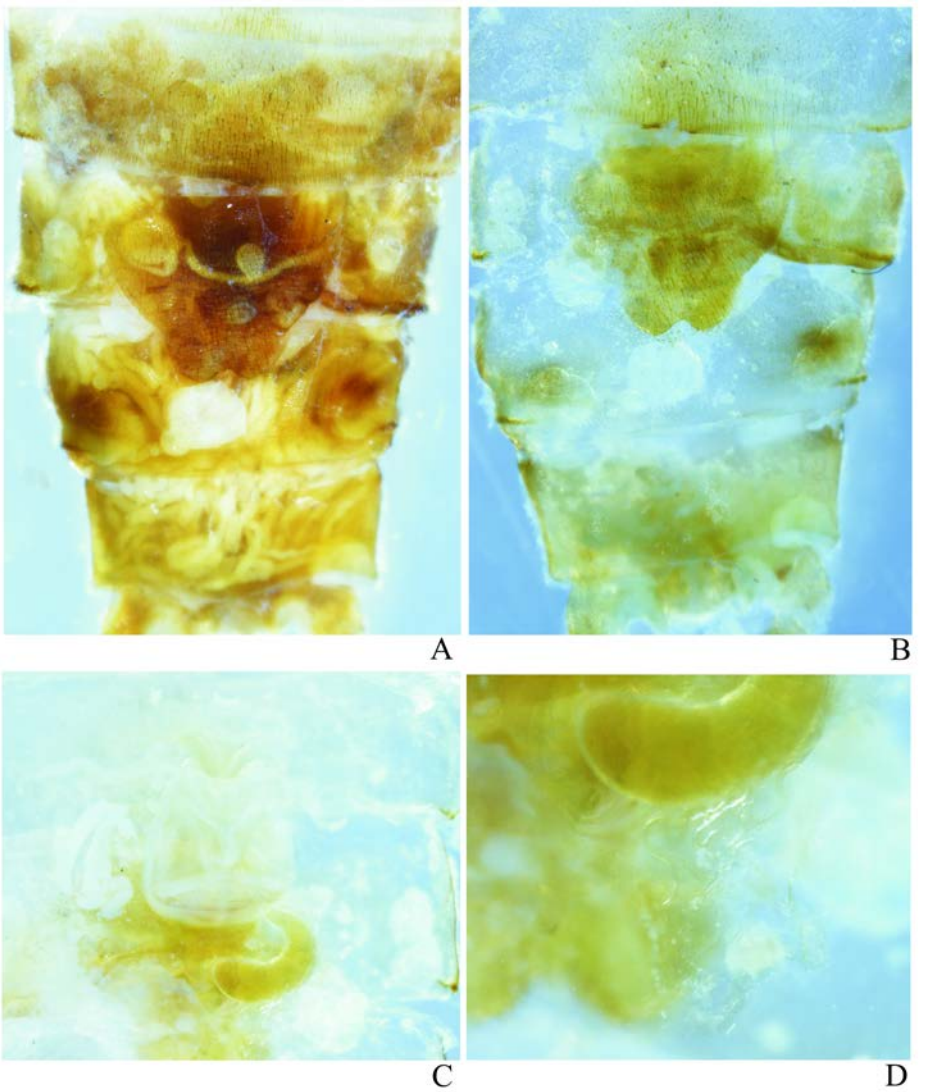

Figure 3. *Togoperla caii* **sp. nov.,** ♀. A. Terminalia, ventral view; B. Terminalia after being cleared, ventral view; C. Vagina, dorsal view; D. Apical half of spermatheca, dorsal view.

2. ***Togoperla hippata* sp. nov.** (Figs 4, 5)

Adult habitus (Fig. 4). General body color brown. Head pale brown, with a large, dark brown subrectangular medial area laterally interrupted by a pair of slender and oval tentorial callosities, and with a dark brown subtriangle in frontal region. Compound eyes dark; antennae brown, basal half of scape pale brown. Pronotum dark brown, rectangular, with indistinct rugosities; anterior corners pointed and posterior corners obtuse (Fig. 4A). Wing membrane brown, veins dark brown. Legs dark brown; femora and tibiae with wide pale band, nearly half of total length; basal half of tarsi paler (Fig. 4B). Abdominal segments brownish.

Male (Figs 4C–E, 5). Forewing length 21.5–24.5 mm. Mid-posterior margin of tergum 5 produced as a trapezoidal emarginate lobe. Terga 6–9 typical, with anterior margin and lateral areas sclerotized and midsection membranous; membrane of terga 6–9 hairy (Figs 4C–4E).

Hemitergal process forward of basal callus slightly shorter than basal callus, apex wide and obtusely rounded in lateral view, basal callus bearing sensilla basiconica (Figs 4C–4E). Aedeagus membranous, hammer-shaped, apically abruptly constricted to a finger-shaped lobe (Fig. 5); aedeagus before full eversion hippo-like in lateral view (Fig. 5C). Aedeagal tube naked, dorsobasally with a large tongue-shaped lobe. Aedeagal sac bulging, basal half fully covers brownish spinules but dorsomedially interrupted by a membranous band (Fig. 5A); apical half naked, with a pair of small dorsolateral lobes and a longer finger-shaped apicomedial lobe.

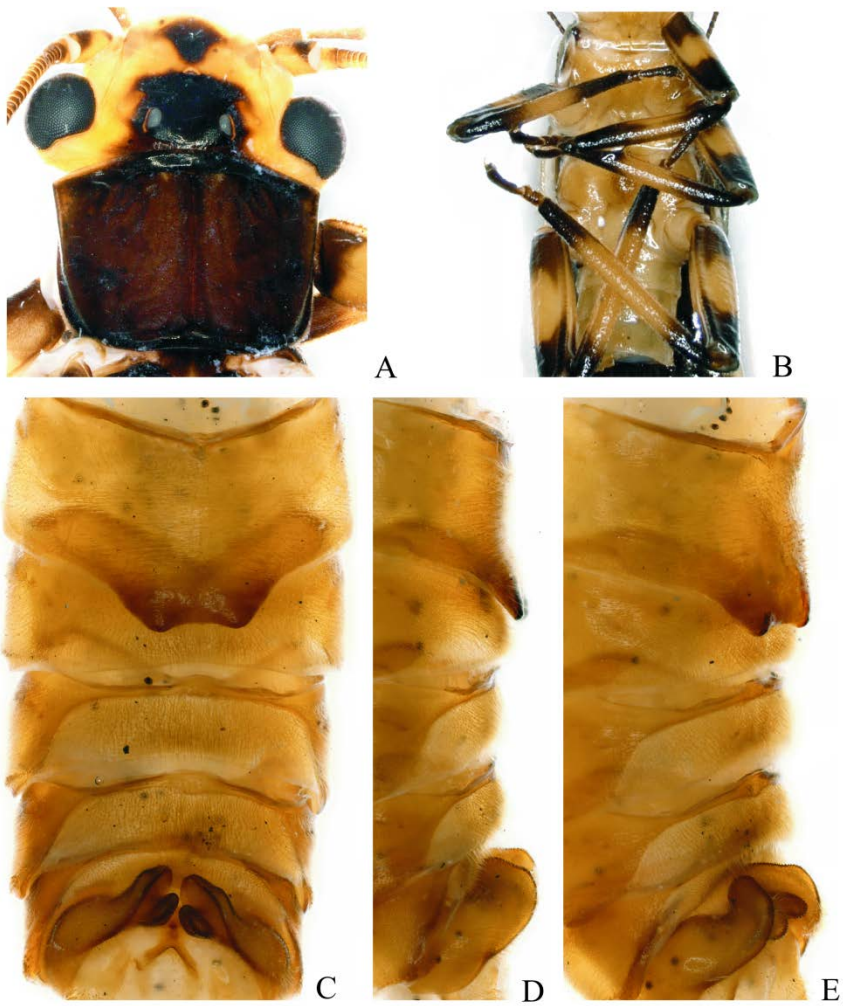

Figure 4. *Togoperla hippata* **sp. nov.**, ♂. A. Head and pronotum, dorsal view; B. Legs, ventral view; C. Terminalia, dorsal view; D. Terminalia, lateral view; E. Terminalia, oblique lateral view.

Female and eggs. Unknown.

Holotype. ♂(HIST), **China**, Guangxi, Nanning, Wuming, Liangjiang, Neichao Village, Neichao Hotel, 23°29′32" N, 108°21′29" E, 194.2 m, light trap, 20-V-2020, Yan LAI, Yingying MO & Raorao MO. **Paratypes**. 1♂(HIST), same data as holotype; 3♂(HIST), same

data as holotype, light trap, 18-V-2020; 1♂(HIST), same data as holotype, light trap, 19-V-2020; 1♂(HIST), Guangxi, Guilin, Longsheng, Huaping National Nature Reserve, Cujiang Station, 25°38′00" N, 109°54′31" E, 750 m, 01-VI-2020, Yan LAI.

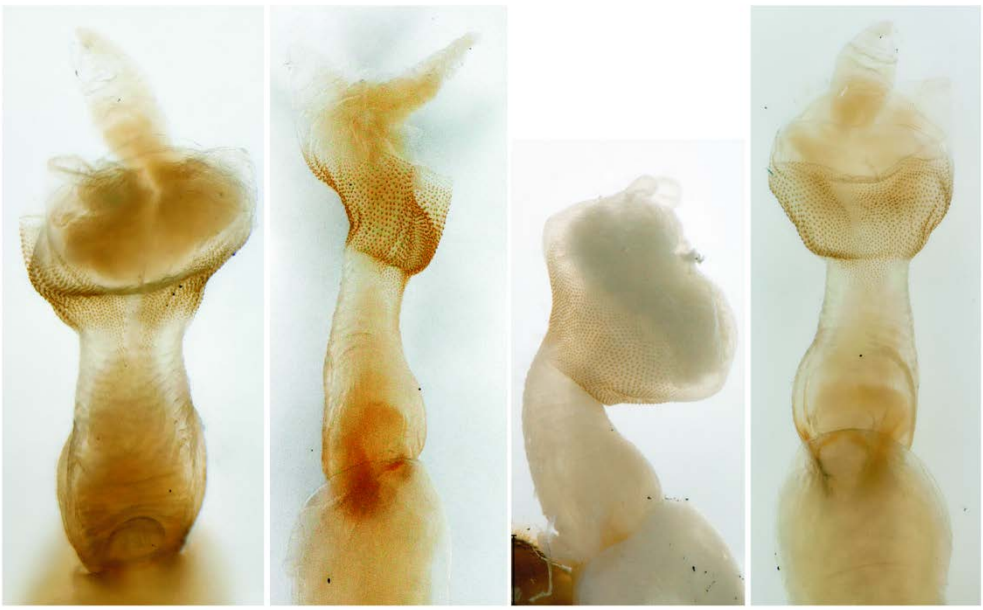

Figure 5. *Togoperla hippata* **sp. nov.**, ♂. A. Aedeagus, dorsal view; B. Aedeagus, lateral view; C. Aedeagus before full eversion, lateral view; D. Aedeagus, ventral view.

Etymology. The species epithet refers to the hippo-shaped of the aedeagus before eversion (Fig. 5C).

Remarks. See above discussion under *Togoperla caii* **sp. nov.**

3. ***Togoperla perpicta* Klapálek, 1921** (Figs 6, 7)

Specimens examined. 1♂(CAU), 1♂(HIST), **China**, Guangxi, Baise City, Tianlin, Mt. Cenwanglaoshan, Meteorological station, 24°25'17" N, 06°23'0" E, 1333 m, 30-IV-2012, Zejian LI & Yafei SHANG; 1♂(HIST), 3♂(NMP), Guangdong, Lianzhou, Nanling National Nature Reserve, Mt. Dadongshan, border of mixed forest, collected at light, 24°56.0' N, 112°42.9' E, 690 m, 18–21-IV-2013, J. Hájek & J. Růžička.

Distribution. China (Fujian, Guangdong, Guangxi, Hong Kong, Zhejiang); Vietnam.

Remarks. This species was originally described from Hong Kong in south China by Klapálek (1921). It was re-described in detail and discussed by Sivec *et al*. (1988) and Stark & Sivec (2008). And it was previously recorded from Fangchenggang City on the south coast of Guangxi (Du & Sivec 2004). Currently, two male specimens from Baise City in western Guangxi and four male specimens from Lianzhou City in northern Guangdong agree well with the original and complementary illustrations and descriptions of this species (Klapálek 1921; Sivec *et al*. 1988; Stark & Sivec 2008). Four males from Mt. Dadongshan represent the first record of this species from Guangdong Province. We provide additional color illustrations (Figs 6, 7) for aiding in the recognition of this species.

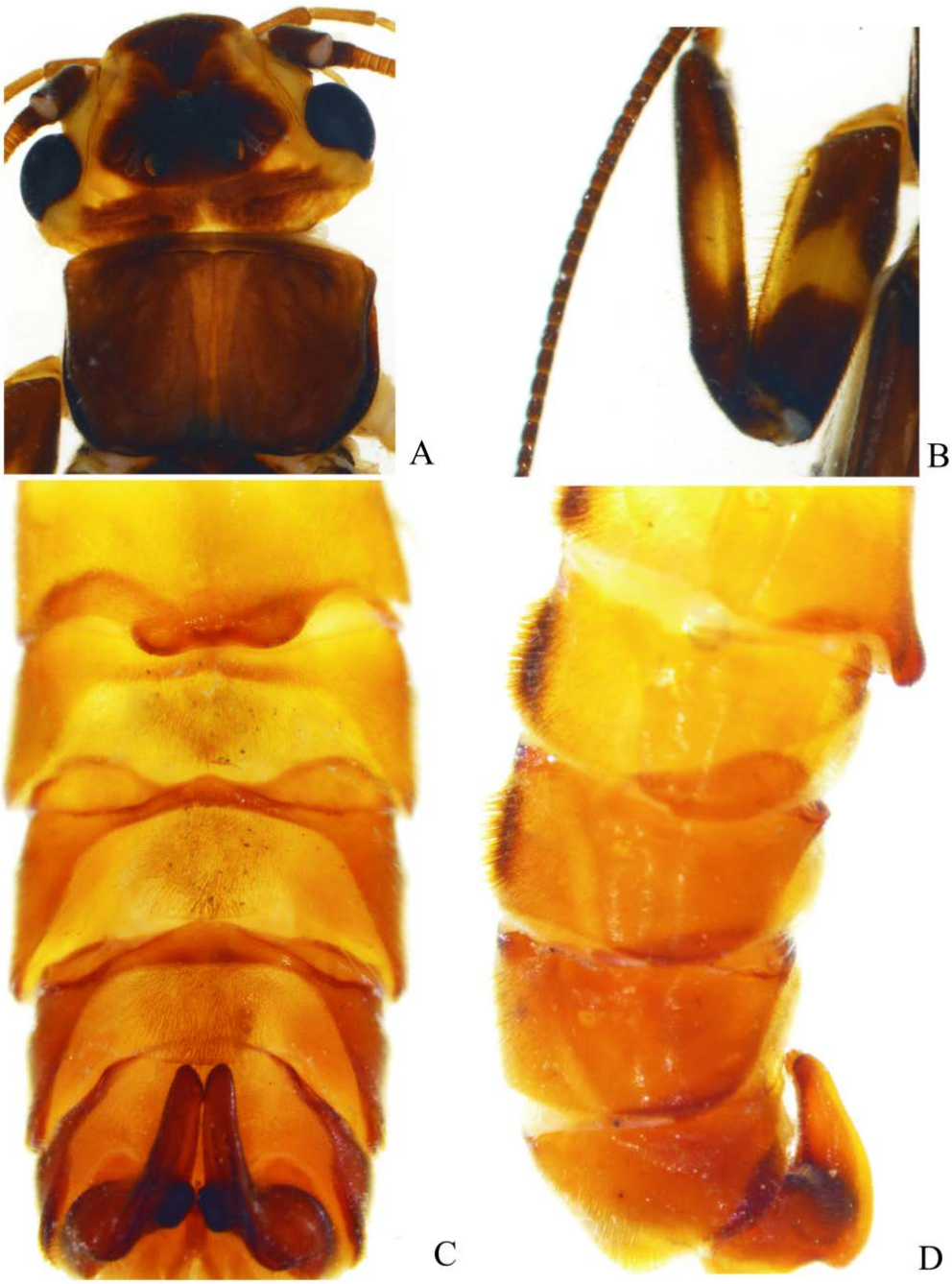

Figure 6. *Togoperla perpicta* Klapálek, 1921, ♂. A. Head and pronotum, dorsal view; B. Left fore leg, outer face; C. Terminalia, dorsal view; D. Terminalia, lateral view.

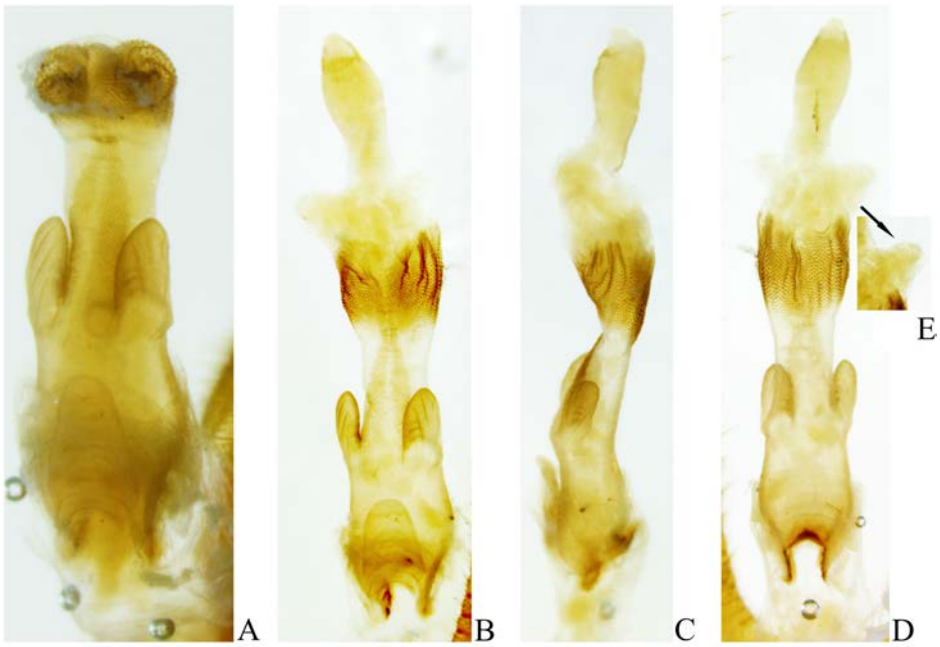

Figure 7. *Togoperla perpicta* Klapálek, 1921, ♂. A. Aedeagus before full eversion, dorsal view; B. Aedeagus, dorsal view; C. Aedeagus, lateral view; D. Aedeagus, ventral view; E. Left dorsolateral lobe of aedeagal sac, ventral view.

4. ***Togoperla triangulata* Du & Chou, 1999** (Figs 8, 9)

Redescription. Adult habitus (Fig. 8). General body color brown. Head mostly brown, with a large, dark brown subtrapezoidal medial area laterally interrupted by a pair of slender and oval tentorial callosities, and with a dark brown subtriangle in frontal region; M-line pale brown; occiput with a pair of pale areas. Compound eyes dark; antennae brown, basal portion darker. Pronotum brown, trapezoidal, with distinct rugosities and a pair of paler lateral areas; anterior corners pointed and posterior corners obtuse (Fig. 8A). Wing membrane brown, veins dark brown. Legs mostly dark brown; basal two thirds of femora pale (Fig. 8C). Abdominal segments brownish.

Male (Figs 8B, 8D–G, 9). Forewing length 19.0–21.5 mm. Mid-posterior margin of tergum 5 produced as a trapezoidal emarginate lobe. Terga 6–9 typical, with anterior margin and lateral areas sclerotized and midsection membranous; membrane of terga 6–9 hairy (Figs 8B, 8D, 8G). Hemitergal process about twice as long as basal callus, apically covered with several sensilla basiconica; triangular in lateral view; basal callus bearing sensilla basiconica (Figs 8B, 8D–G). Aedeagus membranous, tubular, apically abruptly constricted to a slender heart-shaped lobe (Fig. 9). Aedeagal tube naked, dorsobasally with a longer tongue-shaped lobe, and dorsolaterally with a pair of small apical lobes. Aedeagal sac mostly covered with brownish spinules, except for dorsobasal and apical area (Fig. 9A); apical half naked, with a pair of small obscure dorsolateral lobes and a slender heart-shaped medial lobe.

Female and eggs. Unknown.

Specimens examined. 1♂(CAU), 1♂(HIST), **China**, Guangxi, Baise, Tianlin, Mt. Cenwanglaoshan, Dalongping, 24°21' N, 106°15' E, 1300 m, 23-V-2013, Guoquan WANG.

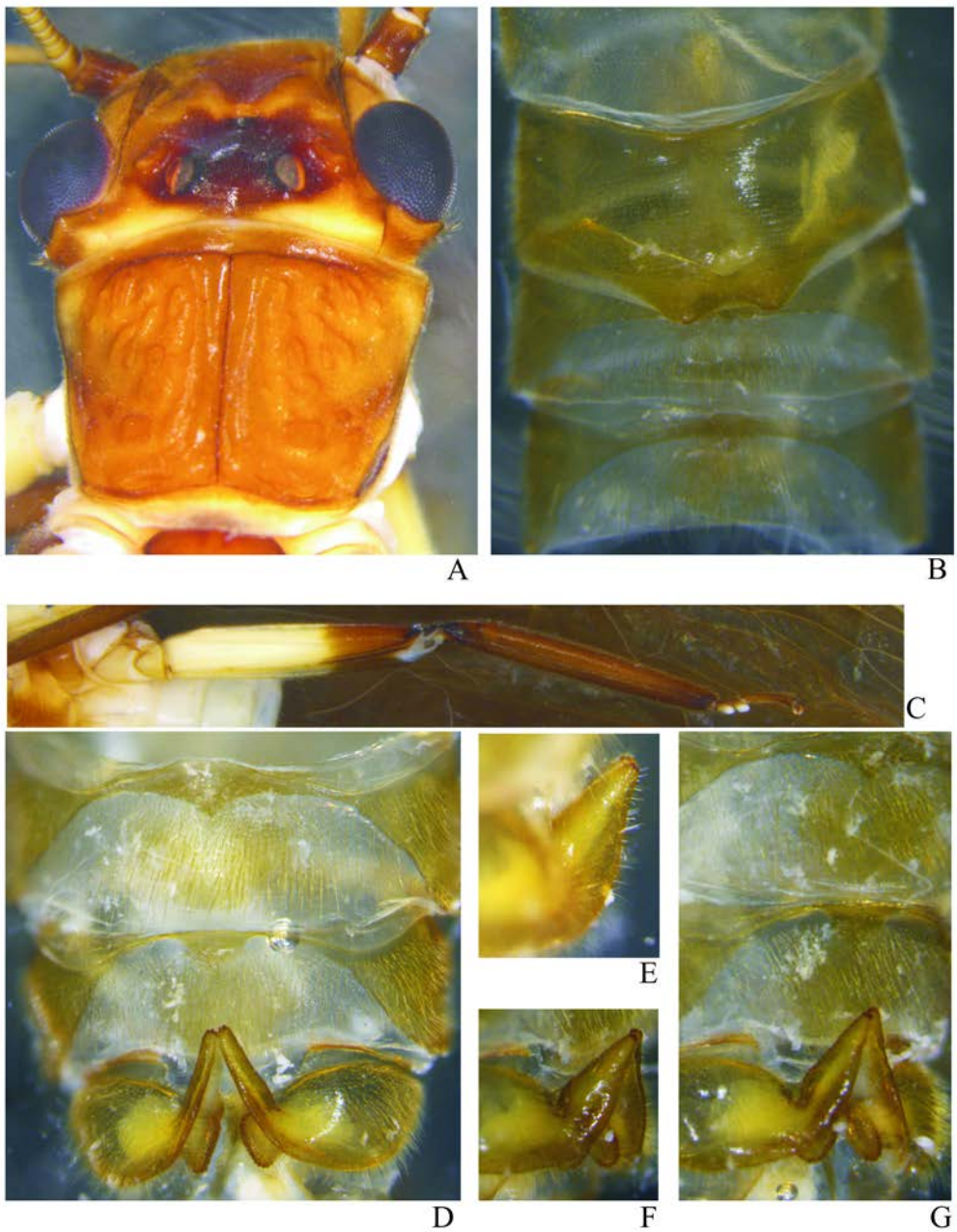

Figure 8. *Togoperla triangulata* Du & Chou, 1999, ♂. A. Head and pronotum, dorsal view; B. Terga 5–7, dorsal view; C. Left hind leg, inner face; D. Terga 8–10, dorsal view; E. Hemitergal process, lateral view; F. Hemitergal process, oblique lateral view; G. Terga 8–10, oblique lateral view.

Distribution. China (Guangxi).

Remarks. Two males from Mt. Cenwanglaoshan examined in this study agree well with original illustrations and description of the terminalia and aedeagus, especially the hemitergal lobe, aedeagal tube and apical armatures of the aedeagal sac (compare figs 6, 7 in Du & Chou 1999 and Figs 8, 9). But the aedeagus of the holotype was possibly not fully everted, the

apical lobe being absent in the original illustration. The color pattern of legs are different from our specimens: in original description, legs yellow, subapical part of femora and basal and apical part of tibiae dark brown, tarsi dark brown; but this is possibly due to intraspecific differences, such differences having been documented in the cases of *T. brevispinis* Yoshinari, Uchida & Nakamura, 2016 and *T. limbata* (Pictet, 1841) (Yoshinari *et al*. 2016). Or it is possible the leg pattern is not decisive in this genus or it possibly represents a different species. This species is related to the Japanese *T. limbata* (Pictet, 1841) and the Vietnamese *T. poilanina* (Navás, 1934) in sharing a similar head pattern, hemitergal processes of moderate length and triangular in lateral view, aedeagal tube with a larger basal lobe and a pair of smaller apical dorsolateral lobes, aedeagal sac mostly covered with spinules and with a naked apical half and an apicomedial lobe. However, this species is easily separated from them by a bare dorsal surface of basal half of aedeagal sac, and a pair of obscure dorsolateral lobes and a naked slender heart-shaped apicomedial lobe of the aedeagal sac. Additionally, the small apical lobes of aedeagal tube of *T. triangulata* and *T. poilanina* is naked, while in *T. limbata*, these lobes are fully armed with spinules. In *T. limbata*, the basal two thirds of the aedeagal sac is fully covered with spinules, the dorsolateral lobes of aedeagal sac is distinctly longer, and the apicomedial lobe is fully armed with fine setal spines. In *T. poilanina*, dorsal surface of aedeagal sac is covered with a rectangular band of spinules, the dorsolateral lobes of aedeagal sac are short and distinct, and the apicomedial lobe is shorter and obscure.

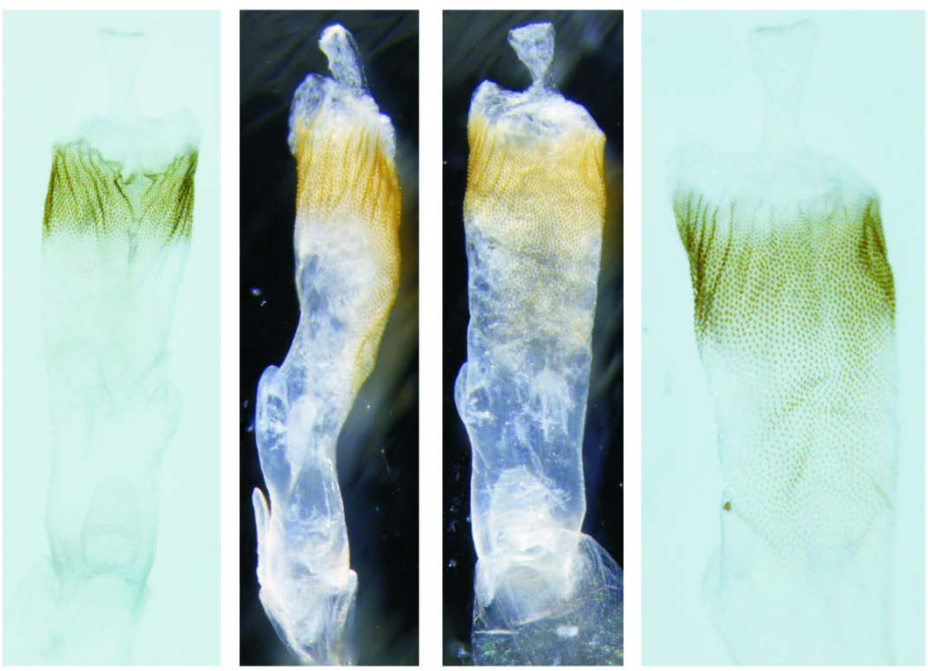

Figure 9. *Togoperla triangulata* Du & Chou, 1999, ♂. A. Aedeagus, dorsal view; B. Aedeagus, lateral view; C. Aedeagus, ventral view; D. Aedeagal sac, ventral view.

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References

DeWalt RE, Maehr MD, Hopkins H, Neu-Becker U & Stueber G. 2021. Plecoptera Species File Online. Version 5.0/5.0. Available from: http://Plecoptera.SpeciesFile.org (Accessed 11 March 2021)

Du YZ & Chou I. 1999. Notes on Chinese species of the genus *Togoperla* Klapálek (Plecoptera: Perlidae: Perlinae). *Entomotaxonomia*, 21: 1–8.

Du YZ & Sivec I. 2004. Plecoptera: Perlidae, Nemouridae, Leuctridae. *In*: Yang XK (Ed.), *Insects from Mt. Shiwandashan Area of Guangxi*. China Forestry Publishing House, Beijing, pp. 39–45.

Klapálek F. 1907. Japonské druhy rodu *Perla* Geoffr. *Rozpravy Ceske Akademie Cisare Frantiska Josefa*, 16: 1–28.

Klapálek F. 1921. Plécoptères nouveaux. *Annales de la Societe Entomologique de Belgique*, 61: 57–67, 146–150, 320, 327.

Li WH & DeWalt RE. 2012. A new species of *Togoperla* (Plecoptera: Perlidae) from China with a revised key to *Togoperla* males. *Zootaxa*, 3564(1): 54–60.

Navas RPL. 1926. Algunos insectos del Museo de Paris. *Brotéria Série Zoológica*, 23: 106.

Navas RPL. 1934. Névropteres et insectes voisins. Chine et pays environnants. *Notes d'Entomologie Chinoise, Musée Heude*, 2(1): 9–12.

Pictet FJ. 1841. *Histoire naturelle générale et particulière des insectes Névroptères*. *Famille des Perlides.* Kessmann-Baillière, Genève-Paris, 423 pp.

Sivec I, Stark BP & Uchida S. 1988. Synopsis of the world genera of Perlinae (Plecoptera: Perlidae). *Scopolia*, 16: 1–66.

Stark BP & Sivec I. 2008. The genus *Togoperla* Klapálek (Plecoptera: Perlidae). *Illiesia*, 4: 208–225.

Wu CF. 1935. Aquatic insects of China. Article XXI. New species of stoneflies from East and South China. (Order Plecoptera). *Peking Natural History Bulletin*, 9: 227–243.

Wu CF. 1938. *Plecopterorum sinensium: A Monograph of Stoneflies of China* (*Order Plecoptera*). Yenching University, Beijing, 225 pp.

Wu CF & Claassen PW. 1934. Aquatic insects of China. Article XXI. New species of Chinese stoneflies. (Order Plecoptera). *Peking Natural History Bulletin*, 9: 111–129.

Yang D & Li WH. 2018. *Species Catalogue of China. Vol. 2. Animals, Insecta* (*III*), *Plecoptera*. Science Press, Beijing, 49 pp.

Yoshinari G, Uchida S & Nakamura M. 2016. Morphological and DNA analyses of Japanese *Togoperla* (Plecoptera, Perlidae), with description of a new species. *Biology of Inland Waters*, 3(supplement): 141–156.

Zwick P. 1983. The *Neoperla* of Sumatra and Java (Indonesia) (Plecoptera: Perlidae). *Spixiana*, 6: 167–204.